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BOOK REVIEW

Carabid beetles in their environments, a study on habitat selection by adaptations in physiology and behavior, by Hans-Ulrich Thiele. 1977. Zoophysiology and Ecology Volume 10. Springer-Verlag, Berlin, Heidelberg, New York. 152 figures. XVII, 369 pages. $48.00.

Thiele's volume celebrates the last three decades of carabid ecology. It is a fitting tribute to "the insect family comprising the most species of all" and a splendid corollary to "Die fennoskandischen carabiden" 1945-1949 by Carl H. Lindroth to whom the book is dedicated. The study is based on 585 selected references in which Thiele's results are combined with those of mainly European and North American workers of the 60's and 70's. As a unifying theme Thiele asks ". . . in what manner is a species adapted to its environment and to its way of life, and how have such adaptations come about in the course of phylogenesis?" He observes that carabids are model organisms for investigating such questions as they number an estimated 40,000 species and account for 4.3% of all insect species.

The table of contents is most useful. It presents clear statements for eleven chapters and a maximum of three subcategories within each chapter.

Variations in the body structure of carabids in adaptations to habitat and niche are discussed in Chapter 1. Thiele describes macromorphological variation as a basis for classification of higher taxa. He recognizes that the most pronounced variations in body form are connected with specialized modes of nutrition and adaptations to special environments such as the arboreal one in the tropics, but that these do not throw light on the reasons for the many forms found in forest and open land habitats. Micromorphological variations are also reviewed in relation to various habitats.

Chapter 2 deals with quantitative investigations on the distribution of carabids in forests and open country habitats of temperate climates. An attractive case is made for the use of pitfall traps. While limitations of the method are recognized, Thiele is right when he says "pitfall traps have done much to clarify our quantitative and qualitative picture of the distribution of carabids in different habitats and plant communities". One interesting point which has emerged from recent findings is that the carabid fauna characteristic of cultivated land probably originated from river banks and sea coasts.

Chapter 3 (94 pages) deals with the connections between carabids and biotic factors in the ecosystem. Thiele questions to what degree biotic factors govern the distribution of carabids in different habitats, and population density, and what are carabid influences on populations of their prey. A superbly detailed review on parasites and predators of carabids is provided. It appears that populations of carabids are not greatly affected by parasites. On the other hand, many types of birds, mammals, frogs and lizards, and predaceous flies and ground spiders are important regulators of carabid population densities.

Man and ground beetles are dealt with in Chapter 4. Thiele observes it is now clear that carabids are valuable natural "auxiliaries" in pest control as they cannot on their own check rapidly enough large pest populations from damaging crops and forests. From the standpoint of current issues the section on the influence of man on ground beetles highlights the chapter, and there is a fresh newness in the material. Carabids are shown to be highly sensitive to insecticides, herbicides, industrial and automobile exhaust gases, and other human environmental alterations. This strongly suggests a possible role for carabids as bioindicators of harmful environmental activity of humans.

Chapter 5, which deals with carabid reactions to abiotic factors in the environment, draws a great deal of information from Lindroth's (1945-1949) experimental and field studies, and from Thiele's own group of workers. An extensive survey covering 53 pages includes carabid orientation to temperature, humidity, light, microclimate, chemical factors, and water. One curious and significant experiment described in a small section on the physiological basis of thermotaxis provides a unique explanation of preferred temperature. It was found that in species of *Carabus* the transpiration rate did not rise steadily with increasing temperature but remained constant within a certain narrow temperature range which differed from species to species.

Chapter 6 (the third longest, 41 pages) deals with ecological aspects of activity patterns in carabids. An account of daily rhythmicity in the activity of carabids covers mainly a comprehensive review of the subject by Thiele and Weber. Some species are shown to be day active and others night active. The light-dark change appears to be the most important *zeitgeber* in a circadian rhythm of activity. In a section on annual rhythms in activity, reproduction, and development, it is indicated that carabids are generally univoltine but in cold regions species take several years to develop.

The combined influences of abiotic factors on habitat selection are dealt with in Chapter 7, which is a short summary of the numerous examples illustrated in Chapters 5 and 6. Elements of carabid history comprise Chapters 8, 9, and 10.

Chapter 8, the dispersal and dispersal power of carabid beetles, demonstrates the survival value of macroptery and brachyptery in variable and stable environments respectively. I feel this discussion would have been better placed at the beginning of Chapter 10, which deals with the reasons underlying species profusion manifest by the carabids, such as carabid dispersibility, and plasticity of physiology and behavior in relation to new habitat and niche adjustments. Chapter 9 covers the ecological aspects of the evolution of carabids, including an interesting account of the evolution of carabids on oceanic islands.

Chapter 11 is an excellent three page summary of the entire volume. This is followed by: References; Systematic index of cited families; sub-tribes, and genera; Species index; and Subject index.

The text is an English translation from the German by Joy Wieser. It is lucid and readable, there are few misprints, and most of the reproduced figures are large, well-labelled, and instructive. In all, Thiele's volume is a progress report on carabid biology. It brings together widely different inquiries, many of which are combined to shed light on old questions; but as is the nature of science, new and challenging questions are revealed, and some of these presently have no counterpart.

I recommend this volume not only to every serious student of ground beetle biology, but also to those interested in terrestrial arthropod biology.

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